Cost Utility of Public Clinics to Increase Pneumococcal Vaccines in the Elderly

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Background: Pneumococcal immunization has been shown to be cost effective, is recommended by the Advisory Committee on Immunization Practices, and is covered by Medicare. Despite that, over 50% of the population aged ≥65 is not vaccinated, leading to significant mortality and morbidity. The objective of this study is to evaluate the costs and the cost utility of immunization in nontraditional settings (community clinics set up to provide influenza and pneumococcal vaccinations) as a strategy to increase pneumococcal immunization rates.

Methods: A cost-utility analysis of public immunization clinics in Monroe County, New York, during the fall of 1998. The study included 1207 adults aged ≥65. Costs of operating the clinics and of vaccine administration were measured. The cost of health sequela and estimates of quality-adjusted life years (QALYs) were obtained from prior studies. Sensitivity analyses were performed to test several important assumptions.

Results: Unlike immunizations in physician offices, immunizations in nontraditional settings are not cost saving. Estimates of incremental cost-utility ratios ranged from $4215 per QALY to $12,617 per QALY, depending on the underlying assumptions of the model.

Conclusions: Clinics in nontraditional settings offering pneumococcal immunization have cost-utility ratios near and below those of other recommended vaccines. These results suggest that such clinics should be considered a viable strategy for increasing pneumococcal immunization rates.

Medical Subject Headings (MeSH): aged; aged, 80 and over; bacteremia; immunization; cost-benefit analysis; pneumococcal infections (Am J Prev Med 2001;21(1):29–34)

Introduction

Despite the availability of an effective and cost-saving vaccine, pneumococcal disease is still widely prevalent, causing 15,000 deaths and 50,000 cases of bacteremia annually in the United States.[1] The pneumococcal polysaccharide vaccine (PPV) has been recommended by many professional organizations and the Advisory Committee on Immunization Practices (ACIP).[1] Pneumococcal vaccination has also been a covered Medicare benefit since the early 1980s. Despite recommendations and Medicare coverage, as of 1997 only 45% of people aged ≥65 had received the PPV.[2]

Current recommendations by the ACIP[1] and the Task Force on Community Preventive Services[3] for improving immunization rates, especially for populations with limited access to health care, include the administration of vaccines in nontraditional settings in conjunction with education and awareness campaigns. Many communities have established public health clinics specifically for the purpose of providing pneumococcal vaccination and increasing immunization rates.[4,5]

This strategy has been questioned, however. Anecdotal evidence indicates concern among clinicians that such clinics, which provide only immunizations, lack information about the patient's previous immunization history. Furthermore, they may not transmit immunization information to the patient's primary care physician. Insurers are concerned about the costs of reimmunizing patients who do not require a second immunization. Although the cost utility of the vaccine has been demonstrated,[6] the incremental cost utility of efforts to increase immunization rates through such strategies has not been investigated.

The purpose of this study is to estimate the cost utility of offering immunizations in nontraditional settings,

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namely community clinics set up specifically to provide influenza and pneumococcal vaccinations, as a strategy to increase immunization rates. Our analysis is based on data obtained from a demonstration project funded by the Centers for Disease Control and Prevention (CDC; part of the Emerging Infections Program/Active Bacterial Core Surveillance) to increase the rates of pneumococcal immunization in the community, implemented in 1998 in Monroe County (Rochester), New York. This study does not evaluate other strategies for increasing immunization rates, such as a community-wide publicity campaign or academic detailing program to increase physician awareness of the recommendations. Such strategies may also be cost effective and should be examined in future studies.

Description of the Community Clinics Program (CCP)

Monroe County, an urban area in New York State, has a population of approximately 725,000, including 91,000 people aged ≥65.[7] It has a long-established program of public influenza clinics serving approximately 40,000 people each fall. Baseline studies found that the rate of pneumococcal immunization among clients of the public influenza clinics, aged ≥65, was 50% to 60% (N Bennett, unpublished data, Monroe County Department of Health, 1999). Therefore, one strategy adopted to increase PPV levels in the Rochester community was to offer PPV at the public influenza vaccination clinics. This approach also took advantage of the existing infrastructure of the influenza clinics, thus allowing for potential cost savings.

PPV was offered in the 12 public influenza immunization clinics sponsored by the Monroe County Department of Health during September and October 1998. These clinics served 4145 individuals of all ages, of whom 1207 elderly individuals also received PPV.

The process of offering the PPV was integrated into the influenza vaccination process. At intake to influenza vaccination, individuals were offered written information about PPV and asked if they wanted to receive immunization. If they responded positively, they were referred to a separate location within the clinic where nurses interviewed them to determine if they should receive PPV, per standing orders.

Methods

The cost utility of PPV for prevention of bacteremia in people aged ≥65 was demonstrated by Sisk et al.[6] In this study, we accepted their result as proven and focused on estimating the cost utility of administration in nontraditional settings. We assumed that all immunizations provided in these settings would not have occurred in the absence of the CCP. We compared the cost utility of receiving a vaccine through the CCP to no vaccination. The outcomes of interest are the prevention of pneumococcal bacteremia by pneumococcal immunization and the treatment of disease if it occurs.

We relied on the estimates of costs of the treatment of bacteremia, health sequela, and quality-adjusted life years (QALYs) developed by Sisk et al.[6,8] for Monroe County, and we augmented them with our estimates of the PPV administration costs incurred by the CCP. We assumed that the benefits of the vaccination itself are the same irrespective of location (i.e., physician office or community clinic).

Vaccine administration costs were expected to be higher in a nontraditional setting compared to a physician office for two reasons. First, unlike administration in physician offices where the vaccination is an incremental activity, the community clinics are established only for the purpose of providing immunizations and, therefore, bear the full setup costs. Second, there are additional educational and outreach activities associated with the clinics. The vaccine administration costs in this study were based on data collected in the CCP.

Incremental vs Joint Production of Vaccination

Because the CCP offered both pneumococcal and influenza immunizations, many of the costs were incurred in activities associated with both types of immunizations. We attempted to perform time-measurement studies to separate costs associated with pneumococcal immunizations only, but found that it was difficult to separate many of these activities in the hectic environment of the clinic. Therefore, we viewed the clinics as a joint production process with some costs attributed to the two products—influenza and pneumococcal vaccinations. Alternatively, pneumococcal immunizations could be thought of as an incremental activity because influenza clinics have been offered in previous years and would continue to be offered whether or not PPV is offered. In this case, we attributed to the pneumococcal vaccine only those costs that could be separated and directly related to the additional pneumococcal immunization activities. For example, some staff time was solely devoted to activities related to the pneumococcal vaccination. This time was counted both in the incremental calculation and the joint production estimation. Other portions of staff time were spent on activities related to both immunizations and were, therefore, counted only in the joint production case. The following equations define the costs per immunization under each assumption:

$$\text{Joint cost per shot} = (\$\,\text{PPV}/\#\,\text{PPV}) + (\$\,\text{Joint}/(\#\,\text{flu} + \#\,\text{PPV}))$$

$$\text{Incremental costs per shot} = (\$\,\text{PPV}/\#\,\text{PPV})$$

where $ PPV are costs associated with PPV only, $ Joint are costs associated with both immunizations, and # indicates number of immunizations. We present estimates under both assumptions.

Appropriate and Inappropriate Vaccinations

Unlike influenza immunization, which is recommended annually, the recommendation for pneumococcal immunization for most recipients is for one vaccination after age 65.[1] We ascertained prior vaccination status through patient self-report, following the recommendations of the ACIP.[1] Self-report, however, is subject to recall bias[9] and may result in

Table 1. Data and assumptions for cost-utility calculations (1998 $)

Variables	PPV only costs[a]	PPV and flu joint cost[b]	Comments
Community program costs			
Planning ($)[c]			
Staff	844	3,947	Coordinator
Brochures, publications	4,256	2,440	Printing, consent forms
Advertisements	4,000	5,448	
Clinic activities ($)[c]			
Staff			
Salaried	4,330	4,742	Coordinator, nurses, billing, data manager
Clerical	290	1,459	Clerks, temporary help
Student nurses	4,428	5,472	Six student nurses at each site for PPV
Nurse instructors	1,412	2,136	At least two instructors at each site
Community volunteers	825	2,624	Wage of $5.50/hour
Supplies, equipment	100	806	Phone, van, cash register, office supplies
Pneumococcal vaccine cost ($)[c]	12,294	—	
Post-clinic ($)[c]			
Physician notification	664	—	Fax, copy, sort
Total program costs	33,443	29,074	Sum of all cost categories
Number of vaccines given			
Total vaccines[c]	1,207	4,145[e]	
Inappropriate pneumococcal vaccines (%)[10]	27%	27%	
Appropriate vaccines	881	3,819	
Program cost per appropriate vaccine	37.96	9.61	The joint costs calculations assume that costs due to inappropriate vaccination apply only to pneumococcal and not influenza shots.[f]
Expected costs of health sequela per person immunized ($)	60.99	—	Adapted from Sisk et al.,[6,8] subtracting cost of vaccine and its administration.
Total costs per shot	98.95	108.55	Total costs assuming joint production=98.95+9.61.

[a] Data presented in this column were used to calculate cost-utility assuming that the pneumococcal immunization program is incremental to the influenza program: ($ PPV/# PPV).
[b] Data presented in this column was used to calculate the contribution of the joint activities to the cost-utility assuming that pneumococcal immunization and influenza are jointly jointly produced: ($ Joint/(#flu+#PPV)).
[c] Monroe County Department of Health, New York, unpublished data, 1998.
[d] Adapted from Sisk et al.[6,8] Adjusted to 1998 dollars using the medical care component of the consumer price index.
[e] Number of pneumococcal and influenza shots given.
[f] 9.61=(29074/4145)×(1207/881).
PPV, pneumococcal polysaccharide vaccine.

some individuals receiving unnecessary immunizations. If these same individuals were offered a pneumococcal immunization in their physicians' offices, it is likely that their medical records would have been checked, the information about prior vaccination retrieved, and a new vaccine would not have been given. Therefore, provision of immunizations in nontraditional settings may lead to duplicate vaccination costs that should be included in the analysis.

A study of a random sample of the CCP population[10] found that 27% of those vaccinated had reported erroneously that they were not previously vaccinated. We assumed that these individuals incur the costs of the vaccine in the clinic but receive no additional benefits (in terms of both medical cost savings and QALYs) compared to those who were appropriately vaccinated only once. We also assumed that the unnecessary vaccination did not pose any additional costs related to side effects or disutility.

Data

Costs. The data on the costs of the pneumococcal and influenza vaccine program were provided by the Monroe County Department of Health and based on the actual costs of the vaccine and tallies of hours and expenditures for its administration. They included activities in three phases of the program: planning, clinics and billing, and postclinic, primary care physician notification. For each phase we obtained staff time by category (nurses, clerks, nursing student volunteers, and lay volunteers), costs of supplies (e.g., vaccine, brochures, consent forms, copying charges, and fax and telephone costs), costs of advertisements, and cost of equipment. All costs are in 1998 dollars and summarized in Table 1. The table reports both the PPV-only costs and the influenza and PPV joint costs.

To calculate the cost of staff time, each staff person's hours were tallied and then multiplied by their hourly wage plus 25% for benefits. Nursing students' time was valued at a rate of $18 per hour including benefits, the prevailing wage rate in Monroe County for nurses with no experience. The time of the six volunteer nursing instructors was valued at a rate of $34.45 per hour to reflect their experience and base salary. The time for other volunteers was valued at $5.50 per hour, the wage rate for unskilled personnel; the community volunteers were mostly retired individuals who performed unskilled clerical functions such as handing out paperwork and helping

Table 2. Base-case results: costs, QALYs and costs/QALY per vaccination (1998 $)

	Total cost ($)	Total QALYs	Incremental cost ($)	Incremental QALYs gained	Incremental cost/QALY ($/QALY)
No vaccination[a]	78.02	6.35623	—	—	—
Vaccination in physician office[a]	75.15	6.35865	−2.87	0.00242	cost saving
PPV incremental to influenza program[b]	98.95	6.35865	+20.93	0.00242	8,647
PPV jointly produced with influenza program[c]	108.55	6.35865	+30.53	0.00242	12,617

[a] Adapted from Sisk et al.[6,8] Adjusted to 1998 dollars using the medical care component of the consumer price index.
[b] Based on costs reported in Table 1, column 1, per person immunized ($PPV/# PPV).
[c] Based on costs reported in Table 1, columns 1 and 2, per person immunized. ($PPV/#PPV+$ joint/(#PPV+#flu)).
PPV, pneumococcal polysaccharide vaccine; QALY, quality-adjusted life year.

people complete forms. This hourly wage can be viewed as a minimum value of time for these individuals, because they chose not to hire themselves at this rate. It would also be the cost that the county would face if it were to hire temporary unskilled individuals to perform these functions.

Costs of health sequela (i.e., the treatment of adverse events, including bacteremia and anaphylaxis) and savings in treatment costs (from avoided bacteremia cases) following vaccination were taken from Sisk et al.[6,8] We used their estimates for Monroe County and converted them from 1993 dollars to 1998 dollars using the medical care component of the consumer price index. In 27% of the cases in which the immunization was unnecessary because of prior (unreported) vaccination, we assumed zero health sequela costs.

Effectiveness. Data on QALYs were taken directly from Sisk et al.'s[6,8] estimates for those aged ≥65 in Monroe County, New York. In 27% of the cases in which the immunization was unnecessary, we assumed zero QALYs.

Discounting. Sisk et al.'s[6,8] costs and health effects were discounted at 3%. The remaining costs of the CCP were up-front costs and were not discounted.

Results

Base Case

Results of the base-case analysis are presented in Table 2. The table shows total costs, total QALYs, incremental costs, and incremental QALYs gained, and the cost-utility ratio (defined as incremental costs per QALY gained). Estimates are shown for no vaccination, vaccination in physician offices, and vaccination through the county program, computed once as incremental to the influenza clinic and once assuming joint production. We included Sisk et al.'s[6,8] estimates for office vaccination for comparison purposes.

Unlike immunization in private physician offices, which is less costly and more effective than no immunization (and therefore a dominant strategy), the CCP is more expensive than no vaccination. Assuming that PPV and influenza immunization are jointly produced, the costs per person immunized through CCP are higher by $30.53 compared to no vaccination. When PPV is considered incremental to the influenza immunization, the program is less expensive but still more costly, by $20.93 per person, compared to no vaccine. The cost-utility ratio for immunization through the public clinic is $8647 per QALY gained if the program is considered incremental, or $12,617 per QALY gained if the program is considered jointly produced.

Sensitivity and Threshold Analyses

To investigate the sensitivity of the results to the assumptions made and to identify scenarios under which a community immunization program might have lower cost-utility ratios, we evaluated several alternative scenarios. Results are shown in Table 3.

The first scenario varies the percentage of inappropriate pneumococcal vaccinations given in the CCP. This scenario is motivated by the fact that the rate of inappropriate immunizations is likely to increase as the population immunization rate increases. When the percentage of reimmunizations was reduced from 27% to 20%, the cost-utility ratio was $7275 per QALY. When the percentage of inappropriate immunizations was increased to 40%, the cost-utility ratio increased to $12,045.

We also examined three scenarios that vary assumptions about the costs of the CCP. In the first, we replaced Sisk et al.'s[6,8] Monroe County cost and QALY estimates with their national estimates, which had higher costs and lower QALYs. The differences in the estimates for Monroe County and the national average reflect the relatively lower costs of medical care in Monroe County and differences in the age profile of the population.[11,12] In this scenario, as in the base case, the CCP is not cost saving. However, the cost-utility ratio is lower, at $4215 per QALY.

The second scenario tests the sensitivity of the results to the cost of volunteer time by assuming that their time is valued at zero. This assumption may be justified by considering the benefits of participation that volunteers may experience (e.g., educational benefit or utility gained from participating in volunteer activities) as sufficient to offset their time costs. The CCP was not cost saving in this scenario either. When the PPV was

Table 3. Sensitivity analyses: costs, QALYs, and cost/QALY per PPV vaccination given (1998 $)

	Total cost[a]	Total QALYs	Incremental cost	Incremental QALYs gained	Incremental cost/QALY ($/QALY)
Sensitivity to percent of PPV given inappropriately					
No vaccination[b]	78.02	6.35623	—	—	—
20% inappropriate	95.62	6.35865	+17.60	0.00242	7,275
40% inappropriate	107.17	6.35865	+29.15	0.00242	12,045
Sensitivity to cost assumptions					
National costs and QALYS					
No vaccination[b]	114.12	6.22478	—	—	—
CCP	128.16	6.22811	+14.04	0.00333	4,215
Volunteer time at zero cost					
No vaccination[b]	78.02	6.35623	—	—	—
CCP	98.01	6.35865	+19.99	0.00242	8,260
Effect of fixed costs: immunizations provided to twice as many (2414) individuals					
No vaccination[b]	78.02	6.35623	—	—	—
CCP	93.73	6.35865	+15.71	0.00242	6,490

[a] Assuming all pneumococcal immunization costs are incremental to the influenza vaccination program (Table 1, column 1).
[b] Adapted from Sisk et al. [6,8] Adjusted to 1998 dollars using the medical care component of the consumer price index.
CCP, Community Clinics Program; PPV, pneumococcal polysaccharide vaccine; QALY, quality-adjusted life year.

considered incremental to the influenza program, the cost-utility ratio was $8260 per QALY gained.

The last scenario recognizes that planning and advertisement costs are fixed. Therefore, if the clinics serve more people, fixed costs per vaccination and total costs per vaccination will decline. In this scenario, we assumed that twice as many individuals (2414 rather than 1207) were immunized. The cost-utility ratio in this case is $6490.

In all of these scenarios (except the scenario in which the rate of inappropriate vaccinations was increased), the cost-utility ratio declines. In no instance, however, is the CCP cost saving. To investigate under what conditions the program might be cost saving, we also performed two threshold analyses. We calculated the efficiency that would be required to achieve cost neutrality with the no-vaccination case. Costs would have to be reduced by 87% if the base case assumptions hold, and by 83% if we consider the scenario that assumes the clinic serves twice as many individuals. Such efficiency gains are not very likely.

Discussion

Sisk[8] showed that pneumococcal vaccination in the traditional physician office costs less and improves quality of life compared to not vaccinating. Sisk concluded that pneumococcal vaccination in a physician office should be pursued aggressively. Despite these recommendations, vaccination rates remain low, suggesting that additional interventions—beyond offering pneumococcal vaccine in private physician offices—may be needed to increase immunization rates. The study presented here investigated the cost utility of one strategy, recommended by the ACIP, to increase PPV rates by offering them in nontraditional settings.

Because our study relied on health sequela costs provided by Sisk et al.,[6] the cost-utility ratios we present are based on a medical-care perspective rather than the societal perspective. They do not incorporate costs typically included in the societal perspective, such as future medical care costs and costs of informal care.[13] Furthermore, because we used Sisk et al.'s[6,8] QALY estimates, our analyses implicitly assume that individuals seeking vaccinations at the clinics are similar in terms of their health and age profile to those immunized in physician offices.

Our findings show that increasing immunization rates through public clinics is not a dominant strategy because it does not simultaneously reduce costs and increase QALYs. However, the cost-utility ratios we calculated—with a base case value of $8647 per QALY if costs are considered incremental, $12,617 if we assume joint production, and even lower ratios found in some of the sensitivity analyses—are within the range of cost-utility ratios for many other acceptable medical interventions. Statistics provided by Chapman et al.[14] on 647 medical interventions show a median cost-utility ratio of $12,000. The median for immunizations is lower at $2000, but higher for public health interventions at $14,700, and health education and counseling at $19,500. Higher values were also found for two other vaccines currently recommended by the ACIP: varicella and the hepatitis B vaccines. The cost per life-year saved (not quality adjusted) for varicella vaccine was estimated at $16,000 (1990 dollars) for preschool-aged children.[15] The cost per life-year saved for hepatitis B for newborns was estimated at $38,632.[16] Our estimates, therefore, suggest that community clinics, such as the one offered in Monroe County, may contribute significantly to increasing rates of PPV with an acceptable cost-utility ratio.

In addition, it is likely that the cost utility of the CCP will improve over time. This study was based on the first year of the clinics. Implementing the lessons learned from this experience may lower the costs and improve the program. As our threshold analyses show, however, any realistic efficiency gains are not likely to turn the program into a cost-saving program and, hence, a dominant strategy.

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